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Standard Specification for

ALLOY STEEL CHAIN[1]

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This Standard of the American Society for Testing and Materials is issued under the fixed designation A 391; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

Scope

1. This specification covers heat-treated alloy steel chain which generally is used for slinging, hoisting, and load binding purposes.

NOTE.—This specification does not cover alloy steel chain for pocket wheel applications.

Manufacture

2. (*a*) *Material.*—The alloy steel used in the manufacture of this chain shall be made by the open-hearth, basic-oxygen, or electric-furnace processes.

(*b*) *Welding.*—Each body link shall be welded by the electric welding process. Coupling links and master fittings shall be welded by either the electric-welding or gas-welding process.

NOTE.—Atomic hydrogen welding is considered to be electric welding.

(*c*) *Heat Treatment.*—After welding, chain shall be heat treated before proof testing. Heat treatment shall include quenching and tempering.

Chemical Composition

3. (*a*) The material used shall conform to the following requirements as to chemical composition:

Carbon, max, per cent	0.30
Phosphorus, max, per cent	0.045
Sulfur, max, per cent	0.045

(*b*) The selection and amounts of the alloying elements, which are not a part of this specification are left to the judgment of the individual chain manufacturer.

Check Analysis

4. An analysis may be made by the purchaser from the bars or from the finished chain. Drillings for analysis shall be so taken as to represent the full cross-section of the specimen. The chemical composition thus determined shall conform to the requirements specified in Section 3.

Proof Tests

5. (*a*) All chain shall be proof tested by subjecting it to the proof test load

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[1] Under the standardization procedure of the Society, this specification is under the jurisdiction of the ASTM Committee A-1 on Steel, and is the direct responsibility of Subcommittee A01.27 on Steel Chain.

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prescribed in Table I for the respective size chain, and when so tested it shall stand these loads without showing any defects.

(*b*) Alloy steel chain, when made into slings or assembled with fittings or attachments recommended by the manufacturer, shall be proof tested to the requirements prescribed in Table I. The test shall be applied to all fittings, coupling links, and other component parts. The proof test for master fittings on multiple-branch chains shall be determined by agreement between the manufacturer and the purchaser.

TABLE I.—PROOF TEST LOAD.

Nominal Size, Chain Bar, in.	Proof Test Load, lb, min	Ultimate Strength, lb, min
¼..............	6 500	10 000
⅜..............	13 200	19 000
½..............	22 500	32 500
⅝..............	33 000	50 000
¾..............	46 000	69 500
⅞..............	57 500	93 500
1...............	77 500	122 000
1⅛.............	89 000	143 000
1¼.............	115 000	180 000
1⅜.............	134 000	207 000
1½.............	160 000	244 000
1¾.............	200 000	325 000

(*c*) The manufacturer shall furnish a certificate of proof test to the purchaser or his representative.

Break Tests

6. Test specimens from the finished chain shall conform to the minimum requirements for ultimate strength specified in Table I.

Elongation

7. (*a*) The elongation, as determined by the method specified in Paragraph (*c*), shall be not less than 15 per cent.

(*b*) All chain shall be proof tested before the elongation is measured.

(*c*) Elongation is to be determined as follows: Approximately 10 per cent of the rated proof load for the size of chain being tested is to be applied in order to seat the links properly. The gage length shall then be marked off on the greatest possible number of whole links lying between 10 and 18 in. but, in any event, not less than five complete links in sizes up to 1¼ in. incl and not less than three complete links in sizes over 1¼ in. The load is to be applied with a standard testing machine. As soon as the beam drops or the gage recedes from ultimate load, the machine is to be stopped and the load reduced to the original seating load. The exact distance between the punch marks is to be measured and the original distance between punch marks subtracted. This difference is to be divided by the original distance between punch marks and the result expressed in percentage is the measurement of elongation.

(*d*) If a link in the test section of the chain breaks before the machine can be stopped, as indicated in Paragraph (*c*), the outside length of the broken link and the outside length of the longest link next to it are to be measured and this difference subtracted to determine the length between punch marks at the time of the break. This adjusted length between punch marks represents the total length of elongation, and the percentage of elongation can be determined as indicated in Paragraph (*c*).

(*e*) Fixtures for securing chain in a horizontal chain testing machine shall be properly designed to securely support the shoulder of the link (Note). The opening in the fixture shall be not greater than one and one-fourth times the size of chain being tested. Links in the testing fixture shall not be considered part of the test specimen.

NOTE.—When using a vertical testing machine, U bolts of the same or larger diameter and the same or greater strength than the chain shall be used to secure the chain to the jaws of the testing machine.

(*f*) The test specimen shall be subjected to testing head speeds of not less than 2 in. nor more than 10 in. per min.

Test Specimens

8. Test specimens shall consist of a length not less than 2 ft cut from the finished running length of chain before coupling links are applied. Test specimens shall be heat treated with the chain that they represent.

TABLE II.—WEIGHTS AND DIMENSIONS.

Nominal Size of Chain, in.	Maximum Length of 100 Links, in.	Maximum Weight per 100 ft, lb
1/4	98	84
3/8	134	176
1/2	156	288
5/8	182	453
3/4	208	655
7/8	234	910
1	277	1170
1 1/8	332	1425
1 1/4	371	1765
1 3/8	396	2010
1 1/2	432	2185
1 3/4	503	3020

Number of Tests

9. (*a*) One break test shall be made to represent each lot of 200 ft of chain or fraction thereof.

(*b*) If the test specimen fails to conform to the requirements specified in Section 6, two additional test specimens from the same lot may be tested, each of which shall conform to the requirements specified in Section 6. If both additional tests are satisfactory the chain will be considered acceptable.

Nominal Weights and Dimensions

10. (*a*) The nominal weights and dimensions shall be as prescribed in Table II.

(*b*) The diameter of the bar from which the chain is made shall not be smaller than nominal size less commercial bar tolerance.

Length

11. (*a*) The length shall be determined by measuring to the inside of the end links, and the determination shall be made after the chain has been subjected to the proof test.

(*b*) In determining the length of the chain, a load not exceeding 10 per cent of the proof test load specified in Table I shall be applied to take up the slack.

Workmanship and Finish

12. (*a*) The chain shall be free from injurious imperfections and shall have a workmanlike finish.

(*b*) Prior to testing and inspection at the manufacturer's plant, the chain shall be free from paint or other coating which would tend to conceal defects.

Marking

13. Body chain links shall not be marked with indented characters. Other marking shall be a matter of agreement between the manufacturer and the purchaser.

Inspection

14. (*a*) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. Unless otherwise specified, all tests (except check analysis) and inspection shall be made at the place of manufacture prior to shipment, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

(*b*) The purchaser may make tests to govern the acceptance or rejection of the material at his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

Rejection

15. Unless otherwise specified, any rejection based on tests made in accordance with Section 14 (*b*) shall be reported to the manufacturer within five working days from the receipt of chains by the purchaser.

Rehearing

16. Chains tested in accordance with Section 14 (*b*) that represent rejected material shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

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